Replacing Centralized RTK Reference Networks

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What CORS / NTRIP Currently Provides

CORS (Continuously Operating Reference Stations) and NTRIP (Networked Transport of RTCM via Internet Protocol) form the backbone of precision GNSS positioning today. NOAA-operated CORS in the United States, equivalent national networks elsewhere, plus commercial RTK services (Trimble VRS Now, Hexagon SmartNet, Topcon TopNet Live) provide the centimeter-grade positioning that survey, agriculture, autonomous-vehicle, and mining applications depend on.

The architecture is centralized by design. Each reference station is operated by a credentialed authority; the corrections are broadcast through internet-connected servers; subscriber devices receive corrections through cellular or other connectivity. The deployment scale is significant; the operational maturity is established.

Why Centralized Reference Networks Don't Reach Everywhere

The reference-network model has structural deployment limits. Reference stations cost meaningful capital plus ongoing maintenance; sparse-population geographies don't justify the cost on standalone economics; the cumulative result is that high-

quality precision positioning concentrates in regions where the economics work and is sparse-to-absent elsewhere.

Mining operations, agricultural deployments in remote areas, defense and expeditionary deployments, and autonomous-vehicle operations in non-urban geographies all face the structural limit. Each deployment either invests in private reference infrastructure (mining companies maintaining their own RTK base stations, agricultural operations paying for commercial RTK service coverage) or operates without precision positioning.

How Fleet Calibration Provides the Architectural Alternative

The marker consensus calibration primitive replaces centralized reference stations with fleet self-calibration. Operating units passing markers contribute observations to writable marker memory; consensus refinement produces precision position estimates from aggregated fleet contributions; the precision improves over time as fleet contribution accumulates.

The economics differ structurally. The maintenance burden distributes across the operating fleet rather than concentrating in dedicated reference operators. Geographies with sufficient fleet density gain precision positioning that current centralized economics cannot justify. The architecture supports the deployment geography that current reference-network architecture leaves underserved.

What This Enables for Precision Positioning Geography

Mining operations gain precision positioning across operations geographies that don't justify dedicated reference infrastructure. Agricultural operations gain field-

level precision in remote-rural areas. Autonomous-vehicle operations gain RTK-grade precision in non-urban deployments where centralized RTK is impractical.

The architecture also supports gradual transition. CORS and equivalent reference networks remain valuable where they're deployed; the architectural alternative complements rather than replaces. The patent positions the primitive at the layer where precision positioning extends into the geographies that current centralized economics leave behind.